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~~Insect Control~~,
Investigations.

Feb. 24
~~March 1~~, 1915.

Insect Infestations with
Relation to Injury, Fungi and Mistletoe.

The following observations and tables are compiled from data collected on Form I (Insect Control) on several projects on various Forests in 1913 and 1914.

Only accurate data has been considered. On many of the projects over 50% of the trees have been under 12" in diameter. These trees are generally attacked by Ips and Melanophila and are not subject to decay or injury by lightning. It is therefore obvious that they should not be considered.

The data collected on the Trinity by Mr. O. M. Evans and that on the Sierra (Chiquito Project) by Mr. Ernest Dudley is particularly accurate. Only sheets containing accurate data have been considered.

While percentages in sugar pines have been given the total number is considered as not sufficient to base any definite conclusions. Therefore the data practically only considers the yellow pine (Pinus ponderosa). Up to the pres-

Copy sent Dr. Meinecke.
" " Forester

ent time the percentages show very definitely that epidemics are over 50% in sound trees and that bark borers show a decided preference for trees struck by lightning.

1913.

TRINITY FOREST

Hayfork Project.

819 Trees.

Yellow pine..... 792 trees
Sugar " ..... 27 "

	Y.P.			S.P.
Fire scarred.....	230	=	29.0%	14
Lightning.....	22	=	2.8	3
Mistletoe.....	117	=	14.7	0
Decay.....	23	=	2.9	0

	Y.P.	S.P.
Fire scarred and mistletoe.....	51	0
Fire scarred and decay.....	9	0
" " " lightning.....	4	0
Lightningand mistletoe.....	2	0
Mistletoe and decay.....	2	0
Fire scarred, decay and mistletoe..	5	0
Lightning, decay and mistletoe.....	1	0
	74 = 9.3%	

	Y.P.			S.P.
Fire scarred only.....	161	=	20.3%	14
Lightning only.....	15	=	2.	3
Mistletoe only.....	56	=	7.	0
Decay only.....	6	=	.7	0

	Y.P.			S.P.
Sound.....	480	=	60.7%	10
Not sound (mistletoe & decay).....	132	=	16.6	0
Injured (lightning & fire scarred).	180	=	22.7	17
	792	=	100.0	27

CALIFORNIA FOREST.

Goodyear Project

304 Trees.

Yellow pine..... 236 trees
Sugar " ..... 68 "

	Y.P.		S.P.	
Fire scarred.....	82 =	35.0%	27 =	40.0%
Lightning.....	9 =	3.8	3 =	4.4
Mistletoe.....	47 =	20.	21 =	30.9
Decay.....	4 =	1.7	1 =	1.5

	Y.P.	S.P.
Fire scarred and mistletoe...	18	4 =
" " " lightning...	3	1
Mistletoe and lightning.....	1	0
Total -	22 = 9.3%	5

	Y.P.		S.P.
Fire scarred only.....	62 =	26.3%	22
Lightning only.....	5 =	2.2	2
Mistletoe only.....	28 =	11.8	17
Decay only.....	4 =	1.7	1

	Y.P.		S.P.	
Sound.....	115 =	48.7%	21 =	30.9%
Not sound (mistletoe & decay)	51 =	21.6	22 =	32.3
Injured (lightning & fire scarred)	70 =	29.7	25 =	36.8
	236 =	100.0	68 =	100.0

KLAMATH FOREST

Craggy Project.

178 Trees.

Yellow pine..... 171 trees
Sugar " ..... 7 "

	Y.P.		S.P.
Fire scarred.....	60	= 35%	1
Lightning.....	9	= 5	0
Mistletoe.....	45	= 26	3
Decay.....	33	= 19	0

	Y.P.		S.P.
Fire scarred and mistletoe.....	10	=	1
" " " decay	10		0
" " mistletoe and decay.....	5		0
Lightning and decay.....	4		0
Mistletoe and decay.....	5		0
Total -	34	= 20%	1

	Y.P.		S.P.
Fire scarred only.....	35	= 20.4%	0
Lightning only.....	5	= 2.9	0
Mistletoe only.....	25	= 14.6	2
Decay only.....	9	= 5.3	0

	Y.P.		S.P.
Sound.....	63	= 36.8%	4
Not sound (mistletoe and decay)....	68	= 39.7	3
Injured (lightning & fire scarred).	40	= 23.5	0
Total -	171	= 100.0	7

1913

KLAMATH FOREST

Seiad Project.

112 Trees.

Yellow pine..... 98 trees
Sugar " ..... 14 "

	Y.P.			S.P.
Fire scarred.....	28	=	28.5%	10
Lightning.....	8	=	8.2	3
Mistletoe.....	26	=	26.5	1
Decay.....	4	=	4.1	1

	Y.P.	S.P.
Fire scarred and mistletoe.....	6	1
" " " lightning.....	0	2
" " " decay.....	0	1
Mistletoe " "	1	0
Total -	7 = 7.2%	4

	Y.P.			S.P.
Fire scarred only.....	22	=	22.4%	6
Lightning only.....	8	=	8.2	1
Mistletoe only.....	19	=	19.4	0
Decay only.....	3	=	3.	0

	Y.P.			S.P.
Sound.....	39	=	39.8%	3
Not sound (mistletoe and decay)....	29	=	29.6	2
Injured (lightning & fire scarred).	30	=	30.6	9
Total -	98	=	100.0	14

1913

SIERRA FOREST

Contour Project

348 Trees.

Yellow pine.....319 trees
Sugar " ..... 29 "

	Y.P.			S.P.
Fire scarred.....	69	=	21.6%	6
Lightning.....	3	=	1	0
Mistletoe.....	87	=	27.2	0
Decay.....	17	=	5.3	1

	Y.P.
Fire scarred and mistletoe.....	12
" " " decay.....	3
" " mistletoe and decay...	3
Mistletoe and decay.....	4
" " lightning.....	1
Total - 23	= 7.2%

	Y.P.			S.P.
Fire scarred only.....	51	=	16.0%	6
Lightning only.....	2	=	.6	0
Mistletoe only.....	67	=	21.	0
Decay only.....	7	=	2.2	1

	Y.P.			S.P.
Sound.....	169	=	53.0%	22
Not sound (mistletoe & decay).....	97	=	30	1
Injured (lightning & fire scarred).	53	=	17	6
	319		100.0	29

November 11, 1913.

SUMMARY

1761 Trees.

Yellow pine ..... 1616 trees
Sugar " ..... 145 "

	Y.P.		S.P.	
Fire scarred.....	469	= 29.0%	58	= 40.0%
Mistletoe	322	= 20.	25	= 17.2
Lightning.....	51	= 3.8	9	= 6.2
Decay	81	= 5.	3	= 2.

	Y.P.	S.P.
Fire scarred and lightning.....	7	3
" " " mistletoe.....	97	6
" " " decay.....	22	1
Mistletoe and decay.....	12	0
" " lightning.....	4	1
Lightning " decay.....	4	0
" mistletoe and decay.....	1	0
Fire scarred, " " "	13	0
	160 = 9.9%	11 = 7.6%

	Y.P.		S.P.	
Fire scarred only	331	= 20.5%	48	= 32.4%
Mistletoe only.....	195	= 12.	19	= 13.1
Lightning only.....	35	= 2.2	6	= 4.1
Decay only.....	29	= 1.8	2	= 1.4

	Y.P.		S.P.	
Sound.....	866	= 53.6%	60	= 41.4%
Not sound (mistletoe & decay).....	377	= 23.3	28	= 20
Injured (lightning & fire scarred)	373	= 23.1	57	= 38.6
	1616	= 100.0%	145	= 100.0%

Sound except for fire scars..... 1197 yellow pines or 74%

Mistletoe, decay and lightning... 419 yellow pines or 26%

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TRINITY FOREST

504 Trees.

Yellow pine..... 446 trees
Sugar pine..... 58 "

	Y.P.		S.P.	
Fire scarred	113	= 25.3%	23	= 39.6%
Mistletoe	102	= 25.	11	= 19.
Lightning	57	= 12.8	16	= 27.6
Decay	17	= 3.8	3	= 5.2

	Y.P.	S.P.
Fire scarred & mistletoe	30	3
" " " decay	7	1
" " " lightning	5	2
" " mistletoe & decay	2	0
" " " " lightning	1	3
Mistletoe & decay	1	0
" " lightning	5	1
Lightning & decay	3	0
	54 = 12.1%	10 = 17.2%

Fire scarred only	68	= 15.3%	14	= 24.2%
Mistletoe "	63	= 14.1	4	= 6.9
Lightning "	43	= 9.6	10	= 17.2
Decay "	7	= 1.6	2	= 3.5

	Y.P.		S.P.	
Sound	211	= 47.3%	18	= 31.0%
Not sound(mistletoe & decay)	119	= 26.7	14	= 24.2
Injured (lightning & fire scarred).	116	= 26.0	26	= 44.8
	446	= 100.0%	58	= 100.0%

1914

CALIFORNIA FOREST

Goodyear Project

129 Trees.

Yellow pine..... 96 Trees
Sugar pine..... 33 "

	Y.P.		S.P.	
Fire scarred.....	29	= 30.2%	23	= 70.0%
Mistletoe.....	27	= 28.1	5	= 15.1
Lightning.....	10	= 10.4	3	= 9.1
Decay.....	4	= 4.1	3	= 9.1

	Y.P.	S.P.
Fire scarred and mistletoe.....	4	3
" " " lightning.....	5	1
" " " decay.....	1	3
" " mistletoe & decay.....	1	0
" " mistletoe & lightning.	2	0
	13 = 13.5%	7 = 21.2%

	Y.P.		S.P.	
Fire scarred only.....	16	= 16.7%	11	= 33.3%
Mistletoe.. "	20	= 20.8	2	= 6.1
Lightning "	3	= 3.1	2	= 6.1
Decay "	2	= 2.1	0	= 0

	Y.P.		S.P.	
Sound.....	42	= 43.7%	11	= 33.3%
Not sound (mistletoe & decay).....	30	= 31.3%	8	= 24.2
Injured (lightning & fire scarred)	24	= 25.0%	14	= 42.5
	96	= 100.0%	33	= 100.0%

1914

STANISLAUS FOREST

505 Trees.

Yellow pines..... 479
Sugar " 26

	Y.P.		S.P.	
Fire scarred.....	92 =	19.2%	9 =	34.7%
Mistletoe.....	50 =	10.4	0	
Lightning.....	1 =	.2	0	
Decay.....	0		0	

	Y.P.	S.P.
Fire scars and mistletoe.....	13	0
Mistletoe & lightning.....	1	0
	14 = 2.9%	

	Y.P.		S.P.	
Fire scarred only.....	79 =	16.5%	9 =	34.7%
Mistletoe only.....	36 =	7.5	0	
Lightning only.....	0		0	
Decay only.....	0		0	

	Y.P.		S.P.	
Sound.....	350 =	73.1%	17 =	62.3%
Not sound (mistletoe & decay).....	50 =	10.4	0	
Injured (lightning & fire scarred)...	79 =	16.5	9 =	37.7
	479 =	100.0	26 =	100.0

1914

SIERRA FOREST

Chiquito Project

415 Trees

Yellow pine..... 292 Trees
Sugar pine..... 44 "
Jeffrey pine..... 79 "

	Y.P.		J.P.		S.P.	
Fire scarred.....	52	= 17.8	17	= 21.5%	15	= 34.1%
Mistletoe.....	102	= 35.	23	= 29.	8	= 18.1
Lightning.....	42	= 14.4	1	= 1.3	9	= 20.4
Decay.....	10	= 3.4	1	= 1.3	4	= 9.1

	Y.P.	J.P.	S.P.
Fire scarred & mistletoe.....	13	7	2
" " " decay.....	3	1	1
" " " lightning.....	5	0	4
" " mistletoe & decay...	1	0	2
" " lightning " mistletoe	1	1	0
Mistletoe and decay.....	3	0	0
" " lightning.....	7	0	0
" decay & lightning.....	0	0	1
	33 = 11.3%	9 = 11.4%	10 = 22.7%

	Y.P.	J.P.	S.P.
Fire scarred only.....	29 = 10.0%	8 = 10.1%	6 = 13.6%
Mistletoe "	77 = 26.3%	15 = 19.	3 = 6.7
Lightning "	29 = 10.	0	4 = 9.1
Decay "	6 = 2	0	0

	Y.P.	J.P.	S.P.
Sound	118 = 40.4%	47 = 59.5%	21 = 47.7%
Not sound (mistletoe & decay)	111 = 38.	24 = 30.4	9 = 20.5
Injured (lightning & fire scarred)	63 = 21.6	8 = 10.1	14 = 31.8
	292 = 100%	79 = 100%	44 = 100%

SIERRA FOREST

Mariposa.

140 Trees.

Yellow pines..... 118 Trees
Sugar pines..... 22 "

	Y.P.		S.P.	
Fire scarred.....	28 = 23.7%		8 =	36.4%
Mistletoe.....	11 = 9.3		1 =	4.5
Lightning.....	1 = .8%		0	
Decay...	9 = 7.6%		0	

Mistletoe and decay.....	1
" " fire scarred.....	3
Decay and fire scarred.....	4
	8 = 7%

	Y.P.		S.P.	
Fire scarred only.....	21 = 17.8%		8 =	36.4%
Mistletoe only.....	7 = 6.		1 =	4.5
Lightning "	1 = .8		0	
Decay "	8 = 6.8		0	

	Y.P.		S.P.	
Sound.....	73 = 61.8%		13 =	59.1%
Not sound (mistletoe & decay).....	23 = 19.5		1 =	4.5%
Injured (lightning & fire scarred).	22 = 18.7		8 =	36.4%
	118 = 100.0%		22 =	100.0%

1914.

SIERRA FOREST

Stevenson Creek

139 Trees.

Yellow pine..... 139 Trees

Fire scarred.....	41	= 29.5
Mistletoe.....	55	= 39.5
Lightning.....	14	= 10.1
Decay.....	4	= 2.9

Fire scars and mistletoe.....	17	=
" " " lightning.....	3	
" " mistletoe & lightning....	2	
" " " " decay	1	
Mistletoe & lightning.....	4	
" " decay.....	1	
	28	= 20.1%

Fire scar only.....	18	= 12.9%
Mistletoe "	30	= 21.6
Lightning "	9	= 6.5
Decay only.....	2	= 1.5

Sound.....	52	= 37.4%
Not sound (mistletoe & decay).....	57	= 41.
Injured (lightning & fire scarred).	30	= 21.6
	139	= 100.0%

1914

SIERRA FOREST

Blue Canyon

287 Trees.

Yellow pine..... 287 Trees

Fire scarred	46	or 16.0%
Mistletoe	79	or 27.5%
Lightning	21	or 7.3%
Decay	3	or 1.0%

Mistletoe and fire scarred	12
" " lightning	1
" " decay	1
" lightning & fire scarred	11
" " ".decay	1
Fire scarred & decay	1
	27 trees or 9.4%

Fire scarred only	22	or 7.7%
Mistletoe only	53	or 18.4%
Lightning only	8	or 2.8%
Decay only	0	

Sound	177	or 61.7%
Not sound (mistletoe & decay)	80	or 27.9%
Injured (lightning & fire scarred)	30	or 10.4%
	287	100.0%

SUMMARY.

3119 Trees.

Yellow pines.....	1857 Trees
Sugar "	183 "
Jeffrey "	79 "

	Y.P.		S.P.	
Fire scarred.....	401	= 21.6%	78	= 42.6%
Mistletoe.....	426	= 22.9	25	= 13.7
Lightning.....	146	= 7.9	28	= 15.3
Decay.....	47	= 2.5	10	= 5.5

	Y.P.		S.P.
Fire scarred and mistletoe.....	92	=	8
" " " lightning.....	18	=	7
" " " decay.....	16	=	5
Mistletoe and decay.....	7	=	0
Mistletoe & lightning.....	18	=	1
Lightning and decay.....	3	=	0
Fire scars, mistletoe & decay.....	5	=	2
" " " & lightning.....	17	=	3
Mistletoe, decay & lightning.....	1		1
	177	= 9.5%	27 = 14.7%

	Y.P.		S.P.	
Fire scarred only.....	253	= 13.6%	48	= 26.2%
Mistletoe only.....	286	= 15.4	10	= 5.5
Lightning only.....	93	= 5.	16	= 8.8
Decay only.....	25	= 1.4	2	= 1.1

	Y.P.		S.P.	
Sound.....	1023	= 55.1%	80	= 43.7%
Not sound (mistletoe & decay)	470	= 25.3	32	= 17.5
Injured (lightning & fire scarred)...	364	= 19.6	71	= 38.8
Total -	1857	= 100.0%	183	= 100.0

Sound except for fire scars, 1276 yellow pines or 68.7%
Mistletoe, decay and lightning, 581 yellow pines or 31.3%.

Summary 1913-1914.

Yellow pines------- 3473 Trees.

Fire scarred----------	870	=	25.0%
Mistletoe----------	748	=	21.2
Lightning----------	197	=	5.6
Decay----------	128	=	3.7

Fire scarred and mistletoe----------	189		
" " " lightning----------	25		
" " " decay----------	38		
Mistletoe and decay----------	19		
Mistletoe and lightning----------	22		
Lightning and decay----------	7		
Fire scarred, mistletoe and decay-------	18		
" " " " lightning---	17		
Lightning, mistletoe & decay----------	2		
	337	=	9.7%

Fire scarred only----------	584	=	17.0%
Mistletoe only----------	481	=	13.7
Lightning only----------	128	=	3.6
Decay only----------	54	=	1.6

Sound----------	1889	=	54.4%
Not sound (mistletoe & decay)----------	847	=	24.3
Injured (lightning & fire scarred)-----	737	=	21.3
	3473	=	100.0%

Sound except for fire scars--- 2473 yellow pines or 71.3%
Mistletoe, Decay and Lightning 1000 " " " 28.7%

Fire Scarred Trees.

The total of fire scarred trees in 1914 was less than that of 1913 even with about 200 more trees worked in 1914. The percentage was -

1913 = 29.0%
1914 = 21.6%

The only two Forests comparable, however, are the Trinity and California where control work on the same area has been performed for two years. Here the percentages of fire scarred trees infested is considerably less in 1914 than in 1913.

Trinity	1913 = 29%	1914 = 25.3%
California	1913 35%	1914 = 30.0%

The percentages of fire scarred trees are as follows:

	1913	1914
Trinity--------	29.0%	25.3%
California-----	35.0	30.2
Stanislaus-----	--	19.2
Klamath		
Craggy - 35%		
Seiad - 28.5%		
Sierra---------	21.6%	
Chiquito--------		17.8%
Mariposa--------		23.7%
Stevenson Cr.---		29.5%
Blue Canon------		16.0%

It does not seem probable that fire scarred trees are any more liable to infestation than trees perfectly sound. This variation of from 16 to 35% is probably indicative of the

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percentage of fire scarred trees on the several areas showing the severity or frequence of past fires on each area.

Mistletoe.

Again comparing the infested trees infected with mistletoe on the Trinity and California for the two years we have -

	1913	1914
Trinity	14.7%	25.0%
California	20.0%	28.1%

This shows a decided increase. It would seem that as the insect infestation approaches the normal the bark borers show a preference for trees attacked by mistletoe. If this is so the control of an area through successive years would gradually eliminate this class of trees, tending to serve another purpose than merely controlling insect depredations and further our ultimate ideal of a healthy forest. The percentages on the different projects range as follows:

	1913	1914
Trinity	14.7%	25.0%
California	20.0	28.1
Stanislaus	--	10.4
Klamath		
Craggy	26.0%	
Seiad	26.5%	
Sierra	27.2%	
Chiquito		35.0%
Mariposa		9.3%
Stevenson Cr.		39.5%
Blue Canon		27.5%

Lightning.

In spotting trees it has been found that, almost without exception, lightning struck trees become infested with insects and that bark borers show a preference for these trees. The trees run from a minimum of .2 to a maximum of 14.4% struck by lightning.

	1913	1914
Trinity	2.8%	12.8%
California	3.8%	10.4%
Stanislaus	--	.2%
Klamath		
Craggy	5.0%	
Seiad	8.2%	
Sierra	1.0%	
Chiquito		14.4%
Mariposa		.8%
Stevenson Cr.		10.1%
Blue Canon		2.8%

The Trinity had one tree to every 2068 acres in 1913 and one tree to every 1218 acres in 1914 struck by lightning.

The California	1 to 3413	acres	in	1913
"	1 to 3666	"	"	1914
Stanislaus	1 to 13740	"	"	1914
Klamath				
Craggy	1 to 1777	"	"	1913
Seiad	1 to 1750	"	"	1913
Sierra				
Chiquito	1 to	"	"	1914
Mariposa	1 "	"	"	"
Stevenson Cr.	1 to	"	"	"
Blue Canyon	1 "	"	"	"

Decay.

The percentage of infested trees having decay seems to be in all cases very small. It would be interesting to know what the percentage is to the stand. If it should tally with that of infested trees it would seem obvious that bark borers do not show a preferance for decayed trees. The percentages of decayed trees are as follows:

	1913	1914
Trinity	2.9%	3.8%
California	1.7	4.1
Stanislaus		0
Klamath		
Craggy	19.0%	
Seiad	4.1	
Sierra	5.3	
Chiquito		3.4
Mariposa		7.6
Stevenson Cr.		2.9
Blue Canon		1.0

At the same time it will be noticed that the percentage of decayed trees on the Trinity and California increased on the second year. The immense range in the percentage of decayed trees may be due to the prevalence of certain fungi locally.

These deductions are not to be considered in any way final. Should the percentage of trees infested with bark borers, which have also mistletoe or decay, increase the third year and all or nearly all of our areas show increases on second and

third years, we can pretty certainly say that in normal infestations there is a preference providing the lightning, mistletoe and decayed trees reach over 50% of the entire infestation.